Data Report on the Distribution and Density of Two Eelgrass Species, *Zostera marina* and *Zostera japonica*, on Roberts Bank, British Columbia

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DATA REPORT ON THE DISTRIBUTION AND DENSITY OF TWO EELGRASS SPECIES, *Zostera marina* AND *Zostera japonica*, ON ROBERTS BANK, BRITISH COLUMBIA

by

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ABSTRACT

Sutherland, T.F., Morrison, S., Petersen, S.A., Levings, C.D., and Hill, P. 2006. Data report on the distribution and density of two eelgrass species, *Zostera marina* and *Zostera japonica*, on Roberts Bank, British Columbia. Can. Data. Rep. Fish. Aquatic Sci. 1181: vi+24p.

Estimates of eelgrass shoot density and biomass were measured at six sampling transects located across the tidal flats of Roberts Bank, British Columbia. Five eelgrass sampling trips took place in June, August, October, and December, 2003 and February, 2004. The sampling transects were positioned perpendicular to the shoreline with 3 transects located north of the Deltaport causeway and 3 transects located within the intercauseway region (between the Deltaport and Ferry Terminal causeways). Shoot density and biomass estimates were carried out for two eelgrass species that exist on the tidal flats (*Zostera marina* and *Zostera japonica)*. These data were collected as part of a larger multidisciplinary project addressing the sensitivity of the Roberts Bank tidal flats to potential changes in wave energy and sediment supply due to climate change.

RÉSUMÉ

Sutherland, T.F., Morrison, S., Petersen, S.A., Levings, C.D., and Hill, P. 2006. Data report on the distribution and density of two eelgrass species, *Zostera marina* and *Zostera japonica*, on Roberts Bank, British Columbia. Can. Data. Rep. Fish. Aquatic Sci. 1181: vi+24p.

Des estimations concernant la densité et la biomasse de pousses de zostères ont été établies pour six transects d'échantillonnage sur les battures du banc Roberts, en Colombie-Britannique. Cinq exercices d'échantillonnage de zostères ont été réalisés en juin, août, octobre et décembre 2003 de même qu'en février 2004. Les transects étaient perpendiculaires au rivage et ont été effectués au nord de la jetée du port de Delta (3) et dans le secteur entre les jetées du port de Delta et de la gare maritime (3). Les estimations concernant la densité et la biomasse des pousses ont été établies pour deux espèces de zostères que l'on trouve dans les battures (*Zostera marina* et *Zostera Japonica*). Ces données ont été recueillies dans le cadre d'un projet pluridisciplinaire portant sur la sensibilité des battures du banc Roberts aux changements potentiels sur le plan de l'énergie des vagues et de l'apport de sédiments dus au changement climatique.

INTRODUCTION

In the northeast Pacific, eelgrass populations influence sediment chemistry, benthic primary production, and the biodiversity of invertebrate communities within the tidal flat environment, which serves as an important habitat for migratory birds (Butler et al. 1987; Iverson et al. 1996) and juvenile salmon (Levings, 1985; 2004). Eelgrass meadows create a low energy environment through the reduction of water exchange as eelgrass blades baffle currents and reduce wave action (Gambi et al. 1990; Granata et al. 2001). As a result, fine-grained organic-rich sediment and detrital particles become trapped and accumulate in the eelgrass beds. The anoxic conditions arising from eutrophied seagrass habitats have been reported to be potentially responsible for comparatively low macroinvertebrate abundances, reducing the trophic resource value of seagrass habitats for commercially important fisheries (Heck *et al.* 1995). The subsequent shift in sediment substrate, organic content, and redox potential may promote a shift in the species composition of an existing infaunal assemblage.

The expansion of an eelgrass bed across a tidal flat (Roberts Bank, British Columbia; Figure 1) was observed to coincide with the construction of two marine port facilities (Harrison, 1987). The expansion of eelgrass on this site occurred at approximately the same time as the introduction of an exotic eelgrass species, *Zostera japonica*, which colonized the mid to high intertidal zone of the tidal flats. Further changes to the tidal flat environment and eelgrass populations may take place over time through changes in sea level associated with climate change. It has been suggested that the projected increase in global sea level rise put forward by the International Panel on Climate Change (IPCC) may potentially result in a significant reduction of the Roberts Bank tidal flat, which currently covers an area of 113 km^2 and presently lies within a few metres of mean sea level. In addition, global climate models have predicted an increase in storm intensity over the next century, which may result in the erosion of the lower tidal flats and steepening of the overall slope of the tidal flats. Climate-induced changes to this low-level environment will potentially influence both community and conservation activities, since the Roberts Bank tidal flats are 1) bordered by the Delta municipality and the Tsawwassen First Nation Reserve, 2) the site of the Deltaport and Tsawwassen ferry terminals, and 3) contain important habitat for a variety of birds and fish.

A multidisciplinary project funded by the Canadian Climate Change Impacts and Adaptation Program (CCIAP) and lead by P.Hill was designed to address the present morphodynamic state of the Roberts Bank tidal flats and determine the sensitivity of the tidal flat profile to seasonal variations in wave energy and sediment supply. Eelgrass density and biomass was measured across the tidal flats during 5 field trips over a period of one year, since eelgrass is of ecological importance as it provides a substrate for salmon prey (Kitting, 1984) and promotes sediment stability (Fonseca and Fisher, 1986). These data records can be used to assess future changes to eelgrass populations across the tidal flats due to climate changes or further anthropogenic developments associated with Roberts Bank.

METHODS AND MATERIALS

FIELD SAMPLING

Sampling stations were located along 5 transects (A through F) spanning the high to low intertidal region of Roberts Bank, British Columbia (Figures 1 and 2). Transects A, B and C were located northwest of the Delta port causeway, while transects D, E and F were located between the Delta port causeway and the Tsawwassen ferry terminal causeway (intercauseway region). Eelgrass samples were collected during 5 sampling trips that took place in June 2003, August 2003, October 2003, December 2003, and February 2004 at low tide. Eelgrass shoot samples were collected from 3 replicate quadrats placed randomly on the sediment surface at sampling stations containing eelgrass. The quadrats were made from connected rulers consisting of an area of 0.0472 m^2 (June 2003 trip) and 0.06816 m^2 (August 2003-Feb 2004 trips). Care was taken to cut the eelgrass at the sediment interface and keep both the blade and shoot structure of each plant intact. Eelgrass shoots from each quadrat were carefully placed in individual Ziploc bags labelled with the appropriate station information. The samples were stored in a cooler for transportation back to the laboratory. Stations that were inaccessible due to water coverage or time constraints are denoted with a "dash" in the data tables, while stations visited that yielded no eelgrass in the replicate quadrats are represented with zero values.

LABORATORY ANALYSIS

Eelgrass and macroalgae material was removed from each Ziploc bag and placed in an empty wash basin. The vegetation was separated by eelgrass species (*Zostera marina* and *Zostera japonica)* and then further separated by intact shoots and blade fragments. The number of shoots per quadrat was recorded to determine shoot density. The blades of each eelgrass shoot were rinsed with filtered seawater and carefully swiped with a razor blade edge to remove epiphytes, sediment and epifauna. Shoot biomass was determined from wet and dry weight estimates of each eelgrass category using a Sartorius BL610 balance and a VWR 1370 GM gravity oven set at 55°C for 24 hours. The small eelgrass samples indicated by asterisks in the data tables were weighed using a Sartorius BP211D balance with greater sensitivity.

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REFERENCES

Butler, R.W., Kaiser, G.W., and Smith, G.E.J. 1987. Migration chronology, length of stay, sex ratio, and weight of western sandpipers (*Calidris mauri*) on the south coast of British Columbia. Journal of Field Ornithology, 58: 103 – 111.

Fonseca, M.S. and Fisher, J.S. 1986. A comparison of canopy friction and sediment movement between four species of seagrass with reference to their ecology and restoration. Marine Ecology Progress Series, 29 (1): 15 – 22.

Gambi, M.C., Nowell, A.R.M., and Jumars, P.A. 1990. Flume observations on flow dynamics in *Zostera marina* (eelgrass) beds. Marine Ecology Progress Series, 61: 159 – 169.

Godin, J.-G. J. 1981. Daily patterns of feeding behaviour, daily rations, and diets of juvenile pink salmon in two marine bays in British Columbia. Canadian Journal of Fisheries and Aquatic Sciences, 38: 10-15.

Granata, T.C., Serra, T., Colomer, J., Casamitjana, X., Duarte, C.M., and Gacia, E. 2001. Flow and particle distributions in a nearshore seagrass meadow before and after a storm. Marine Ecology Progress Series, 218: 95 – 106.

Harrison, P.G. 1987. Natural expansion and experimental manipulation of seagrass (*Zostera* spp.) abundance and the response of infaunal invertebrates. Estuarine, Coastal, and Shelf Science, 24: 799-812.

Heck Jr., K.L., Able, K.W., Roman, C.T., and Fahay, M.P. Composition, abundance, biomass, and production of macrofauna in a New England estuary: Comparisons among eelgrass meadows and other nursery habitats. Estuaries. 18 (2): 379 - 389.

Iverson, G.C., Warnock, S., Butler, R.W., Bishop, M.A., and Warnock, N. 1996. Spring migration of the western sandpiper (*Calidris mauri*) along the Pacific Coast: a telemetry study. Condor, 98: 10-21.

Kitting, C.L. 1984. Selectivity by dense populations of small invertebrates foraging among seagrass blade surfaces. Estuaries. 7 (4A): 276 - 288.

Levings, C.D. 1985. Juvenile salmonid use of habitats altered by a coal port in the Fraser River estuary, British Columbia. Marine Pollution Bulletin, 17: 248 – 254.

Levings, C.D. 2004. Fish ecology: knowledge and its application to habitat management. (Eds) Groulx, B., J. Luternauer, and D. Bilderback. In: Fraser Delta: Issues in an urban estuary. Geological Survey of Canada Bulletin, 546: 213 - 236.

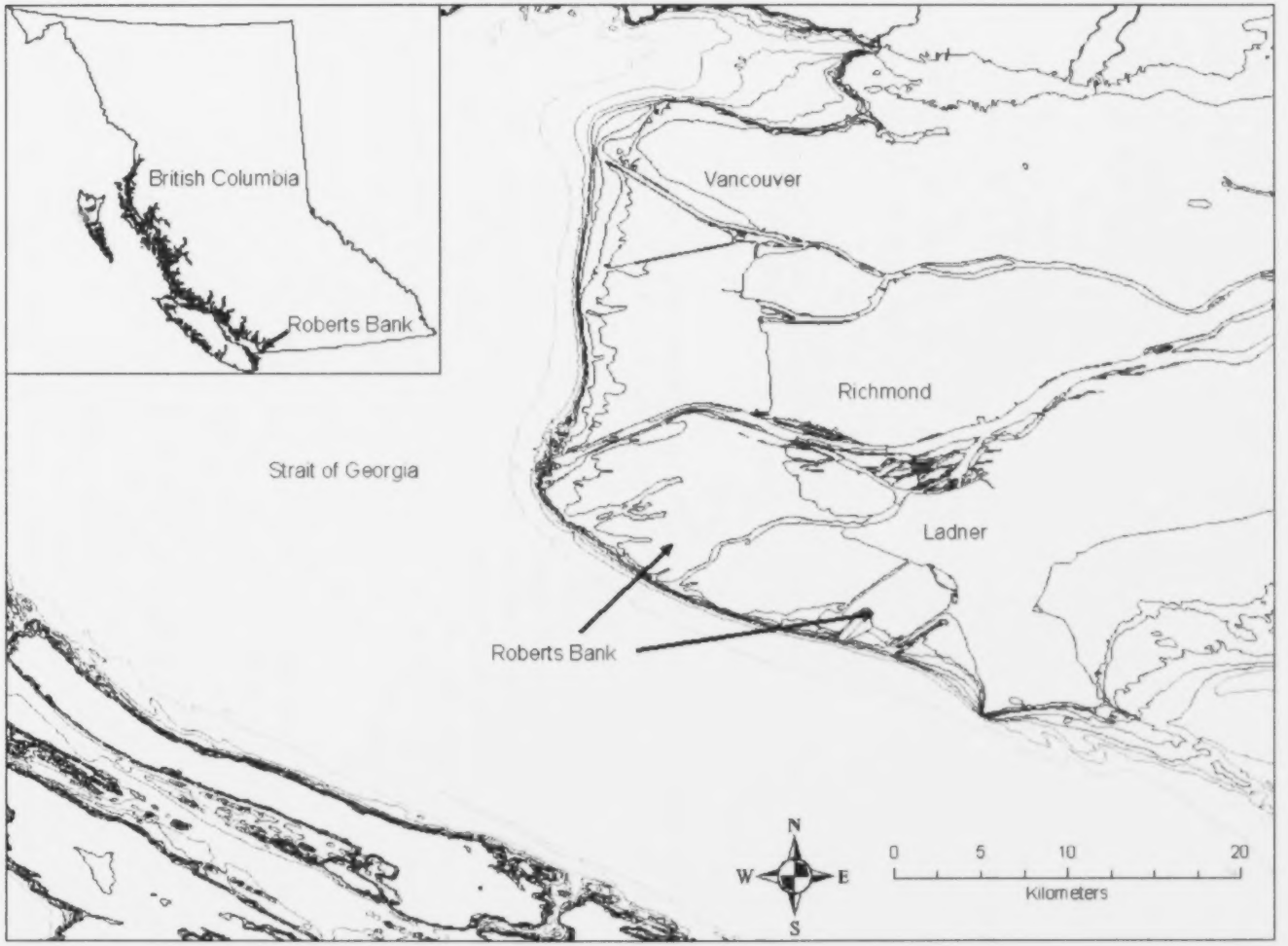

Figure 1. Location of Roberts Bank, British Columbia.

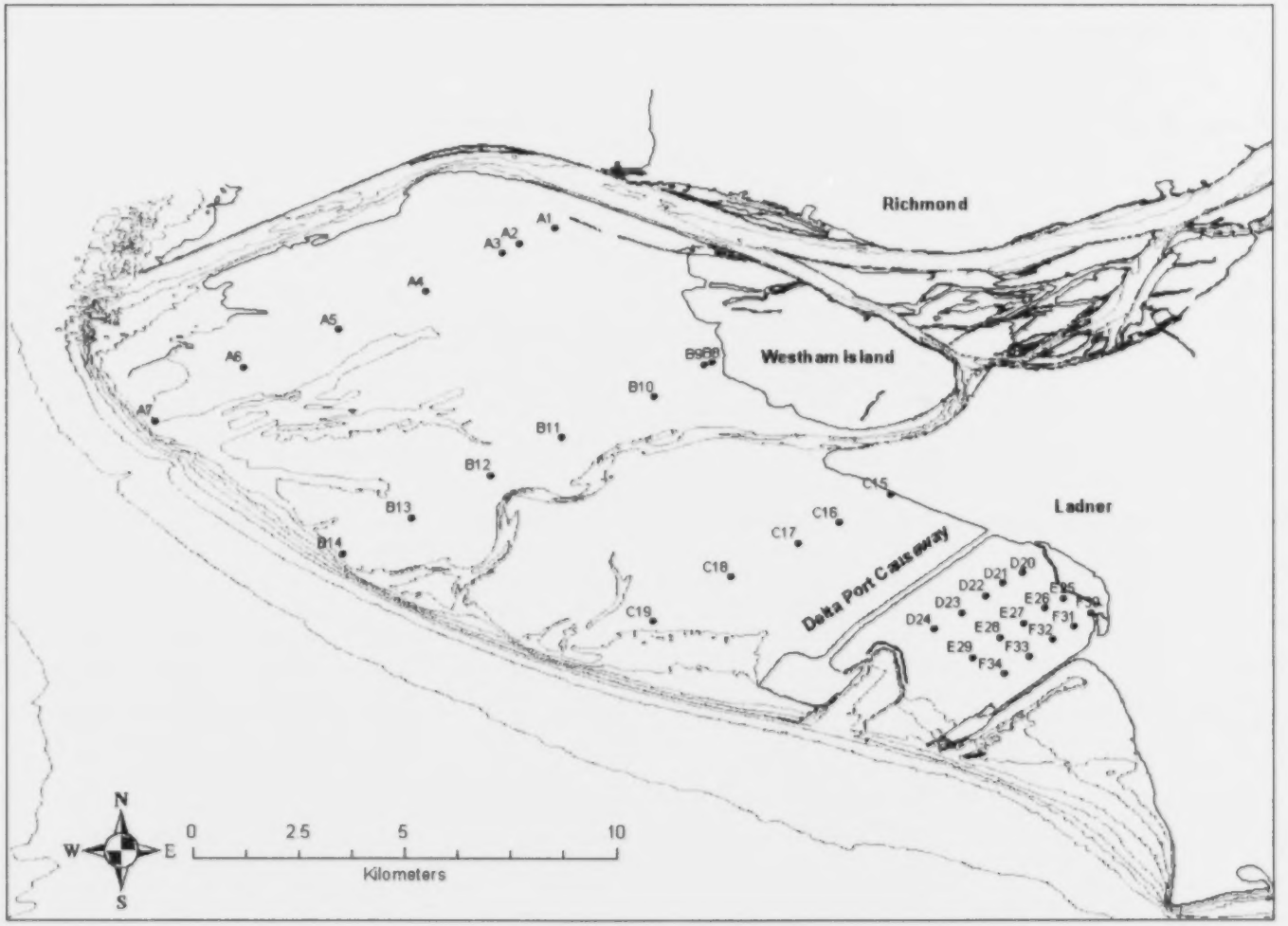

Figure 2. Location of sampling stations at Roberts Bank, British Columbia.

Table 1. Density and biomass estimates of the eelgrass, *Zostera japonica*, on Roberts Bank between June 15-16, 2003 (Std = Standard Deviation). Sampling stations not visited are represented by "-".

Zostera japonica June 2003

Transect A	Shoot Density (no. m^{-2})		Shoot Biomass (g m^{-2})		Transect B	Shoot Density (no. m^{-2})		Shoot Biomass (g m^{-2})		Transect C	Shoot Density (no. m^{-2})		Shoot Biomass (g m^{-2})	
	Mean	Std	Mean	Std		Mean	Std	Mean	Std		Mean	Std	Mean	Std
A1	-	-	-	-	**B8**	-	-	-	-	**C15**	-	-	-	-
A2	0.00	0.00	0.00	0.00	**B9**	-	-	-	-	**C16**	225.99	170.66	1.69	1.51
A3	0.00	0.00	0.00	0.00	**B10**	0.00	0.00	0.00	0.00	**C17**	70.62	39.95	0.56	0.51
A4	0.00	0.00	0.00	0.00	**B11**	0.00	0.00	0.00	0.00	**C18**	0.00	0.00	0.00	0.00
A5	0.00	0.00	0.00	0.00	**B12**	0.00	0.00	0.00	0.00	**C19**	0.00	0.00	0.00	0.00
A6	0.00	0.00	0.00	0.00	**B13**	0.00	0.00	0.00	0.00					
A7	-	-	-	-	**B14**	0.00	0.00	0.00	0.00					

Transect D	Shoot Density (no. m^{-2})		Shoot Biomass (g m^{-2})		Transect E	Shoot Density (no. m^{-2})		Shoot Biomass (g m^{-2})		Transect F	Shoot Density (no. m^{-2})		Shoot Biomass (g m^{-2})	
	Mean	Std	Mean	Std		Mean	Std	Mean	Std		Mean	Std	Mean	Std
D20	247.18	278.04	1.06	0.96	**E25**	155.37	78.00	0.78	0.10	**F30**	-	-	-	-
D21	451.98	379.52	3.25	3.40	**E26**	-	-	-	-	**F31**	-	-	-	-
D22	635.59	261.20	2.33	0.46	**E27**	-	-	-	-	**F32**	-	-	-	-
D23	303.67	95.27	3.11	0.95	**E28**	-	-	-	-	**F33**	-	-	-	-
D24	0.00	0.00	0.00	0.00	**E29**	0.00	0.00	0.00	0.00	**F34**	-	-	-	-

Table 2. Density and biomass estimates of the eelgrass, *Zostera japonica*, on Roberts Bank between August 11-12, 2003 (Std = Standard Deviation). Sampling stations not visited are represented by "-".

Zostera japonica August 2003

Transect A	Shoot Density (no. m^{-2})		Shoot Biomass (g m^{-2})		Transect B	Shoot Density (no. m^{-2})		Shoot Biomass (g m^{-2})		Transect C	Shoot Density (no. m^{-2})		Shoot Biomass (g m^{-2})	
	Mean	Std	Mean	Std		Mean	Std	Mean	Std		Mean	Std	Mean	Std
A1	-	-	-	-	**B8**	-	-	-	-	**C15**	-	-	-	-
A2	0.00	0.00	0.00	0.00	**B9**	-	-	-	-	**C16**	630.87	185.97	2.79	0.79
A3	0.00	0.00	0.00	0.00	**B10**	0.00	0.00	0.00	0.00	**C17**	259.19	366.56	2.49	3.53
A4	0.00	0.00	0.00	0.00	**B11**	0.00	0.00	0.00	0.00	**C18**	0.00	0.00	0.00	0.00
A5	0.00	0.00	0.00	0.00	**B12**	0.00	0.00	0.00	0.00	**C19**	0.00	0.00	0.00	0.00
A6	0.00	0.00	0.00	0.00	**B13**	0.00	0.00	0.00	0.00					
A7	-	-	-	-	**B14**	0.00	0.00	0.00	0.00					

Transect D	Shoot Density (no. m^{-2})		Shoot Biomass (g m^{-2})		Transect E	Shoot Density (no. m^{-2})		Shoot Biomass (g m^{-2})		Transect F	Shoot Density (no. m^{-2})		Shoot Biomass (g m^{-2})	
	Mean	Std	Mean	Std		Mean	Std	Mean	Std		Mean	Std	Mean	Std
D20	308.10	332.84	1.66	1.94	**E25**	621.09	456.83	3.18	2.25	**F30**	0.18	0.25	0.05	0.07
D21	2083.33	817.48	22.35	10.41	**E26**	493.94	398.98	2.10	2.16	**F31**	3.57	2.12	5.72	3.73
D22	914.51	750.43	6.31	6.65	**E27**	-	-	-	-	**F32**	4.29	2.67	15.50	9.06
D23	792.25	749.34	8.71	8.31	**E28**	-	-	-	-	**F33**	-	-	-	-
D24	0.00	0.00	0.00	0.00	**E29**	0.00	0.00	0.00	0.00	**F34**	-	-	-	-

Table 3. Density and biomass estimates of the eelgrass, *Zostera japonica*, on Roberts Bank between October 27-29, 2003 (Std = Standard Deviation). Sampling stations not visited are represented by "-".

Zostera japonica October 2003

Transect A	Shoot Density (no. m^{-2})		Shoot Biomass (g m^{-2})		Transect B	Shoot Density (no. m^{-2})		Shoot Biomass (g m^{-2})		Transect C	Shoot Density (no. m^{-2})		Shoot Biomass (g m^{-2})	
	Mean	Std	Mean	Std		Mean	Std	Mean	Std		Mean	Std	Mean	Std
A1	-	-	-	-	**B8**	-	-	-	-	**C15**	-	-	-	-
A2	0.00	0.00	0.00	0.00	**B9**	-	-	-	-	**C16**	4.89	6.92	0.00070*	0.00099*
A3	0.00	0.00	0.00	0.00	**B10**	0.00	0.00	0.00	0.00	**C17**	4.89	6.92	0.00028*	0.00040*
A4	0.00	0.00	0.00	0.00	**B11**	0.00	0.00	0.00	0.00	**C18**	0.00	0.00	0.00	0.00
A5	0.00	0.00	0.00	0.00	**B12**	0.00	0.00	0.00	0.00	**C19**	0.00	0.00	0.00	0.00
A6	0.00	0.00	0.00	0.00	**B13**	0.00	0.00	0.00	0.00					
A7	-	-	-	-	**B14**	0.00	0.00	0.00	0.00					

Transect D	Shoot Density (no. m^{-2})		Shoot Biomass (g m^{-2})		Transect E	Shoot Density (no. m^{-2})		Shoot Biomass (g m^{-2})		Transect F	Shoot Density (no. m^{-2})		Shoot Biomass (g m^{-2})	
	Mean	Std	Mean	Std		Mean	Std	Mean	Std		Mean	Std	Mean	Std
D20	0.00	0.00	0.00	0.00	**E25**	44.01	31.69	0.20	0.18	**F30**	0.00	0.00	0.00	0.00
D21	34.23	30.15	0.24	0.25	**E26**	0.00	0.00	0.00	0.00	**F31**	19.56	18.30	0.10	0.07
D22	19.56	27.66	0.29	0.41	**E27**	244.52	118.18	1.61	0.52	**F32**	44.01	20.75	0.24	0.18
D23	48.90	59.09	0.49	0.59	**E28**	48.90	49.87	0.34	0.30	**F33**	24.45	18.30	0.34	0.25
D24	4.89	6.92	0.20	0.28	**E29**	0.00	0.00	0.00	0.00	**F34**	0.00	0.00	0.00	0.00

*samples weighed on a more sensitive balance

Table 4. Density and biomass estimates for the eelgrass, *Zostera japonica*, on Roberts Bank between December 22-24, 2003 (Std = Standard Deviation). Sampling stations not visited are represented by "-".

Zostera japonica December 2003

Transect A	Shoot Density (no. m^{-2})		Shoot Biomass (g m^{-2})		Transect B	Shoot Density (no. m^{-2})		Shoot Biomass (g m^{-2})		Transect C	Shoot Density (no. m^{-2})		Shoot Biomass (g m^{-2})	
	Mean	Std	Mean	Std		Mean	Std	Mean	Std		Mean	Std	Mean	Std
A1	-	-	-	-	**B8**	-	-	-	-	**C15**	-	-	-	-
A2	0.00	0.00	0.00	0.00	**B9**	-	-	-	-	**C16**	112.48	36.60	0.05	0.07
A3	0.00	0.00	0.00	0.00	**B10**	0.00	0.00	0.00	0.00	**C17**	112.48	111.30	0.15	0.21
A4	0.00	0.00	0.00	0.00	**B11**	0.00	0.00	0.00	0.00	**C18**	0.00	0.00	0.00	0.00
A5	0.00	0.00	0.00	0.00	**B12**	0.00	0.00	0.00	0.00	**C19**	0.00	0.00	0.00	0.00
A6	0.00	0.00	0.00	0.00	**B13**	0.00	0.00	0.00	0.00					
A7	-	-	-	-	**B14**	0.00	0.00	0.00	0.00					

Transect D	Shoot Density (no. m^{-2})		Shoot Biomass (g m^{-2})		Transect E	Shoot Density (no. m^{-2})		Shoot Biomass (g m^{-2})		Transect F	Shoot Density (no. m^{-2})		Shoot Biomass (g m^{-2})	
	Mean	Std	Mean	Std		Mean	Std	Mean	Std		Mean	Std	Mean	Std
D20	0.00	0.00	0.00	0.00	**E25**	0.00	0.00	0.00	0.00	**F30**	0.00	0.00	0.00	0.00
D21	73.36	54.90	0.24	0.25	**E26**	0.00	0.00	0.00	0.00	**F31**	0.00	0.00	0.00	0.00
D22	19.56	27.66	0.05	0.07	**E27**	0.00	0.00	0.00	0.00	**F32**	0.00	0.00	0.00	0.00
D23	0.00	0.00	0.00	0.00	**E28**	0.00	0.00	0.00	0.00	**F33**	122.26	116.35	0.39	0.45
D24	0.00	0.00	0.00	0.00	**E29**	0.00	0.00	0.00	0.00	**F34**	0.00	0.00	0.00	0.00

Table 5. Density and biomass estimates for the eelgrass, *Zostera japonica*, on Roberts Bank between February 16-17, 2003 (Std = Standard Deviation). Sampling stations not visited are represented by "-".

Zostera japonica February 2004

Transect A	Shoot Density (no. m^{-2})		Shoot Biomass (g m^{-2})		Transect B	Shoot Density (no. m^{-2})		Shoot Biomass (g m^{-2})		Transect C	Shoot Density (no. m^{-2})		Shoot Biomass (g m^{-2})	
	Mean	Std	Mean	Std		Mean	Std	Mean	Std		Mean	Std	Mean	Std
A1	-	-	-	-	**B8**	-	-	-	-	**C15**	-	-	-	-
A2	0.00	0.00	0.00	0.00	**B9**	-	-	-	-	**C16**	0.00	0.00	0.00	0.00
A3	0.00	0.00	0.00	0.00	**B10**	0.00	0.00	0.00	0.00	**C17**	4.89	6.92	0.00062*	0.00088*
A4	0.00	0.00	0.00	0.00	**B11**	0.00	0.00	0.00	0.00	**C18**	0.00	0.00	0.00	0.00
A5	0.00	0.00	0.00	0.00	**B12**	0.00	0.00	0.00	0.00	**C19**	0.00	0.00	0.00	0.00
A6	-	-	-	-	**B13**	0.00	0.00	0.00	0.00					
A7	-	-	-	-	**B14**	0.00	0.00	0.00	0.00					

Transect D	Shoot Density (no. m^{-2})		Shoot Biomass (g m^{-2})		Transect E	Shoot Density (no. m^{-2})		Shoot Biomass (g m^{-2})		Transect F	Shoot Density (no. m^{-2})		Shoot Biomass (g m^{-2})	
	Mean	Std	Mean	Std		Mean	Std	Mean	Std		Mean	Std	Mean	Std
D20	0.00	0.00	0.00	0.00	**E25**	0.00	0.00	0.00	0.00	**F30**	0.00	0.00	0.00	0.00
D21	14.67	20.75	0.00297*	0.00420*	**E26**	0.00	0.00	0.00	0.00	**F31**	14.67	20.75	0.05	0.07
D22	29.34	41.50	0.10	0.14	**E27**	-	-	-	-	**F32**	29.34	31.69	0.10	0.14
D23	78.25	61.47	0.24	0.18	**E28**	0.00	0.00	0.00	0.00	**F33**	352.11	217.94	2.20	1.30
D24	0.00	0.00	0.00	0.00	**E29**	0.00	0.00	0.00	0.00	**F34**	0.00	0.00	0.00	0.00

*samples weighed on a more sensitive balance

Table 6. Density and biomass estimates for the eelgrass, *Zostera marina*, on Roberts Bank between June 15-16, 2003 (Std = Standard Deviation). Sampling stations not visited are represented by "-".

Zostera marina June 2003

Transect A	Shoot Density (no. m^{-2})		Shoot Biomass (g m^{-2})		Transect B	Shoot Density (no. m^{-2})		Shoot Biomass (g m^{-2})		Transect C	Shoot Density (no. m^{-2})		Shoot Biomass (g m^{-2})	
	Mean	Std	Mean	Std		Mean	Std	Mean	Std		Mean	Std	Mean	Std
A1	-	-	-	-	**B8**	-	-	-	-	**C15**	-	-	-	-
A2	0.00	0.00	0.00	0.00	**B9**	-	-	-	-	**C16**	0.00	0.00	0.00	0.00
A3	0.00	0.00	0.00	0.00	**B10**	0.00	0.00	0.00	0.00	**C17**	0.00	0.00	0.00	0.00
A4	0.00	0.00	0.00	0.00	**B11**	0.00	0.00	0.00	0.00	**C18**	0.00	0.00	0.00	0.00
A5	0.00	0.00	0.00	0.00	**B12**	0.00	0.00	0.00	0.00	**C19**	148.31	51.90	98.38	57.05
A6	0.00	0.00	0.00	0.00	**B13**	0.00	0.00	0.00	0.00					
A7	-	-	-	-	**B14**	0.00	0.00	0.00	0.00					

Transect D	Shoot Density (no. m^{-2})		Shoot Biomass (g m^{-2})		Transect E	Shoot Density (no. m^{-2})		Shoot Biomass (g m^{-2})		Transect F	Shoot Density (no. m^{-2})		Shoot Biomass (g m^{-2})	
	Mean	Std	Mean	Std		Mean	Std	Mean	Std		Mean	Std	Mean	Std
D20	0.00	0.00	0.00	0.00	**E25**	0.00	0.00	0.00	0.00	**F30**	-	-	-	-
D21	0.00	0.00	0.00	0.00	**E26**	-	-	-	-	**F31**	-	-	-	-
D22	0.00	0.00	0.00	0.00	**E27**	-	-	-	-	**F32**	-	-	-	-
D23	0.00	0.00	0.00	0.00	**E28**	-	-	-	-	**F33**	-	-	-	-
D24	112.99	39.95	71.68	18.30	**E29**	21.19	0.00	30.86	6.74	**F34**	-	-	-	-

Table 7. Density and biomass estimates for the eelgrass, *Zostera marina*, on Roberts Bank between August 11-12, 2003 (Std = Standard Deviation). Sampling stations not visited are represented by "-".

Zostera marina August 2003

Transect A	Shoot Density (no. m^{-2})		Shoot Biomass (g m^{-2})		Transect B	Shoot Density (no. m^{-2})		Shoot Biomass (g m^{-2})		Transect C	Shoot Density (no. m^{-2})		Shoot Biomass (g m^{-2})	
	Mean	Std	Mean	Std		Mean	Std	Mean	Std		Mean	Std	Mean	Std
A1	-	-	-	-	**B8**	-	-	-	-	**C15**	-	-	-	-
A2	0.00	0.00	0.00	0.00	**B9**	-	-	-	-	**C16**	0.00	0.00	0.00	0.00
A3	0.00	0.00	0.00	0.00	**B10**	0.00	0.00	0.00	0.00	**C17**	0.00	0.00	0.00	0.00
A4	0.00	0.00	0.00	0.00	**B11**	0.00	0.00	0.00	0.00	**C18**	0.00	0.00	0.00	0.00
A5	0.00	0.00	0.00	0.00	**B12**	0.00	0.00	0.00	0.00	**C19**	0.00	0.00	0.00	0.00
A6	0.00	0.00	0.00	0.00	**B13**	0.00	0.00	0.00	0.00					
A7	-	-	-	-	**B14**	0.00	0.00	0.00	0.00					

Transect D	Shoot Density (no. m^{-2})		Shoot Biomass (g m^{-2})		Transect E	Shoot Density (no. m^{-2})		Shoot Biomass (g m^{-2})		Transect F	Shoot Density (no. m^{-2})		Shoot Biomass (g m^{-2})	
	Mean	Std	Mean	Std		Mean	Std	Mean	Std		Mean	Std	Mean	Std
D20	0.00	0.00	0.00	0.00	**E25**	0.00	0.00	0.00	0.00	**F30**	0.00	0.00	0.00	0.00
D21	0.00	0.00	0.00	0.00	**E26**	0.00	0.00	0.00	0.00	**F31**	0.00	0.00	0.00	0.00
D22	0.00	0.00	0.00	0.00	**E27**	-	-	-	-	**F32**	0.00	0.00	0.00	0.00
D23	156.49	163.08	32.96	29.00	**E28**	-	-	-	-	**F33**	-	-	-	-
D24	151.60	36.60	122.65	44.85	**E29**	0.00	0.00	0.00	0.00	**F34**	-	-	-	-

Table 8. Density and biomass estimates for the eelgrass, *Zostera marina*, on Roberts Bank between October 27-29, 2003 (Std = Standard Deviation). Sampling stations not visited are represented by "-".

Zostera marina October 2003

Transect A	Shoot Density (no. m^{-2})		Shoot Biomass (g m^{-2})		Transect B	Shoot Density (no. m^{-2})		Shoot Biomass (g m^{-2})		Transect C	Shoot Density (no. m^{-2})		Shoot Biomass (g m^{-2})	
	Mean	Std	Mean	Std		Mean	Std	Mean	Std		Mean	Std	Mean	Std
A1	-	-	-	-	**B8**	-	-	-	-	**C15**	-	-	-	-
A2	0.00	0.00	0.00	0.00	**B9**	-	-	-	-	**C16**	0.00	0.00	0.00	0.00
A3	0.00	0.00	0.00	0.00	**B10**	0.00	0.00	0.00	0.00	**C17**	0.00	0.00	0.00	0.00
A4	0.00	0.00	0.00	0.00	**B11**	0.00	0.00	0.00	0.00	**C18**	0.00	0.00	0.00	0.00
A5	0.00	0.00	0.00	0.00	**B12**	0.00	0.00	0.00	0.00	**C19**	19.56	27.66	18.97	26.83
A6	0.00	0.00	0.00	0.00	**B13**	0.00	0.00	0.00	0.00					
A7	-	-	-	-	**B14**	0.00	0.00	0.00	0.00					

Transect D	Shoot Density (no. m^{-2})		Shoot Biomass (g m^{-2})		Transect E	Shoot Density (no. m^{-2})		Shoot Biomass (g m^{-2})		Transect F	Shoot Density (no. m^{-2})		Shoot Biomass (g m^{-2})	
	Mean	Std	Mean	Std		Mean	Std	Mean	Std		Mean	Std	Mean	Std
D20	0.00	0.00	0.00	0.00	**E25**	0.00	0.00	0.00	0.00	**F30**	0.00	0.00	0.00	0.00
D21	0.00	0.00	0.00	0.00	**E26**	0.00	0.00	0.00	0.00	**F31**	0.00	0.00	0.00	0.00
D22	0.00	0.00	0.00	0.00	**E27**	0.00	0.00	0.00	0.00	**F32**	0.00	0.00	0.00	0.00
D23	34.23	48.41	3.86	5.46	**E28**	127.15	30.15	42.69	9.36	**F33**	58.69	43.19	20.88	14.79
D24	88.03	31.69	35.50	11.05	**E29**	0.00	0.00	0.00	0.00	**F34**	0.00	0.00	0.00	0.00

Table 9. Density and biomass estimates for the eelgrass, *Zostera marina*, on Roberts Bank between December 22-24, 2003 (Std = Standard Deviation). Sampling stations not visited are represented by "-".

Zostera marina December 2003

Transect A	Shoot Density (no. m^{-2})		Shoot Biomass (g m^{-2})		Transect B	Shoot Density (no. m^{-2})		Shoot Biomass (g m^{-2})		Transect C	Shoot Density (no. m^{-2})		Shoot Biomass (g m^{-2})	
	Mean	Std	Mean	Std		Mean	Std	Mean	Std		Mean	Std	Mean	Std
A1	-	-	-	-	**B8**	-	-	-	-	**C15**	-	-	-	-
A2	0.00	0.00	0.00	0.00	**B9**	-	-	-	-	**C16**	0.00	0.00	0.00	0.00
A3	0.00	0.00	0.00	0.00	**B10**	0.00	0.00	0.00	0.00	**C17**	0.00	0.00	0.00	0.00
A4	0.00	0.00	0.00	0.00	**B11**	0.00	0.00	0.00	0.00	**C18**	0.00	0.00	0.00	0.00
A5	0.00	0.00	0.00	0.00	**B12**	0.00	0.00	0.00	0.00	**C19**	78.25	27.66	24.21	6.57
A6	0.00	0.00	0.00	0.00	**B13**	0.00	0.00	0.00	0.00					
A7	-	-	-	-	**B14**	0.00	0.00	0.00	0.00					

Transect D	Shoot Density (no. m^{-2})		Shoot Biomass (g m^{-2})		Transect E	Shoot Density (no. m^{-2})		Shoot Biomass (g m^{-2})		Transect F	Shoot Density (no. m^{-2})		Shoot Biomass (g m^{-2})	
	Mean	Std	Mean	Std		Mean	Std	Mean	Std		Mean	Std	Mean	Std
D20	0.00	0.00	0.00	0.00	**E25**	0.00	0.00	0.00	0.00	**F30**	0.00	0.00	0.00	0.00
D21	0.00	0.00	0.00	0.00	**E26**	0.00	0.00	0.00	0.00	**F31**	0.00	0.00	0.00	0.00
D22	0.00	0.00	0.00	0.00	**E27**	0.00	0.00	0.00	0.00	**F32**	0.00	0.00	0.00	0.00
D23	0.00	0.00	0.00	0.00	**E28**	78.25	38.51	21.86	11.33	**F33**	53.79	42.07	19.32	15.09
D24	0.00	0.00	0.00	0.00	**E29**	83.14	6.92	62.99	15.98	**F34**	44.01	31.69	42.50	38.93

Table 10. Density and biomass estimates for the eelgrass, *Zostera marina*, on Roberts Bank between February 16-17, 2003 (Std = Standard Deviation). Sampling stations not visited are represented by "-".

Zostera marina February 2004

Transect A	Shoot Density (no. m^{-2})		Shoot Biomass (g m^{-2})		Transect B	Shoot Density (no. m^{-2})		Shoot Biomass (g m^{-2})		Transect C	Shoot Density (no. m^{-2})		Shoot Biomass (g m^{-2})	
	Mean	Std	Mean	Std		Mean	Std	Mean	Std		Mean	Std	Mean	Std
A1	-	-	-	-	**B8**	-	-	-	-	**C15**	-	-	-	-
A2	0.00	0.00	0.00	0.00	**B9**	-	-	-	-	**C16**	0.00	0.00	0.00	0.00
A3	0.00	0.00	0.00	0.00	**B10**	0.00	0.00	0.00	0.00	**C17**	0.00	0.00	0.00	0.00
A4	0.00	0.00	0.00	0.00	**B11**	0.00	0.00	0.00	0.00	**C18**	0.00	0.00	0.00	0.00
A5	0.00	0.00	0.00	0.00	**B12**	0.00	0.00	0.00	0.00	**C19**	0.00	0.00	0.00	0.00
A6	-	-	-	-	**B13**	0.00	0.00	0.00	0.00					
A7	-	-	-	-	**B14**	0.00	0.00	0.00	0.00					

Transect D	Shoot Density (no. m^{-2})		Shoot Biomass (g m^{-2})		Transect E	Shoot Density (no. m^{-2})		Shoot Biomass (g m^{-2})		Transect F	Shoot Density (no. m^{-2})		Shoot Biomass (g m^{-2})	
	Mean	Std	Mean	Std		Mean	Std	Mean	Std		Mean	Std	Mean	Std
D20	0.00	0.00	0.00	0.00	**E25**	0.00	0.00	0.00	0.00	**F30**	0.00	0.00	0.00	0.00
D21	0.00	0.00	0.00	0.00	**E26**	0.00	0.00	0.00	0.00	**F31**	0.00	0.00	0.00	0.00
D22	0.00	0.00	0.00	0.00	**E27**	-	-	-	-	**F32**	0.00	0.00	0.00	0.00
D23	0.00	0.00	0.00	0.00	**E28**	205.40	54.90	27.04	10.05	**F33**	9.78	13.83	0.78	1.11
D24	102.70	23.96	16.14	5.35	**E29**	166.28	48.41	48.61	7.22	**F34**	88.03	35.94	43.08	24.22

Table 11. Replicate and mean values of *Zostera japonica* density and biomass estimates on Roberts Bank between June 15-16, 2003 (Std = Standard Deviation).

Eelgrass - *Zostera japonica*

	Stations						
	C16	**C17**	**D20**	**D21**	**D22**	**D23**	**E25**
GPS	N 49.05273°	N 49.04830°	N 49.04191°	N 49.03983°	N 49.03707°	N 49.03352°	N 49.03658°
	W 123.15477°	W 123.16345°	W 123.11584°	W 123.11993°	W 123.12370°	W 123.12878°	W 123.10715°
Date	Jun 16, 2003	Jun 16, 2003	Jun 16, 2003	Jun 16, 2003	Jun 16, 2003	Jun 16, 2003	Jun 16, 2003
Time (PST)	1200	1100	1430	1600	1530	not recorded	1650
				Density (shoots m^{-2})			
Rep 1	84.75	127.12	635.59	974.58	974.58	360.17	254.24
Rep 2	127.12	42.37	105.93	84.75	338.98	381.36	148.31
Rep 3	466.10	42.37	0.00	296.61	593.22	169.49	63.56
Mean	225.99	70.62	247.18	451.98	635.59	303.67	155.37
Std	170.66	39.95	278.04	379.52	261.20	95.27	78.00
				Biomass (g m^{-2})			
Rep 1	0.42	1.27	2.33	8.05	2.97	4.24	0.85
Rep 2	0.85	0.16	0.85	0.64	2.12	3.18	0.85
Rep 3	3.81	0.24	0.00	1.06	1.91	1.91	0.64
Mean	1.69	0.56	1.06	3.25	2.33	3.11	0.78
Std	1.51	0.51	0.96	3.40	0.46	0.95	0.10

Table 12. Replicate and mean values of *Zostera japonica* density and biomass estimates on Roberts Bank between August 11-12, 2003 (Std = Standard Deviation).

Eelgrass - *Zostera japonica*

	Stations										
	C16	**C17**	**D20**	**D21**	**D22**	**D23**	**E25**	**E26**	**F30**	**F31**	**F32**
GPS	N 49.05273° W 123.15477°	N 49.04830° W 123.16345°	N 49.04205° W 123.11592°	N 49.03983° W 123.11993°	N 49.03707° W 123.12370°	N 49.03352° W 123.12878°	N 49.03658° W 123.10715°	N 49.03443° W 123.11097°	N 49.03352° W 123.10128°	N 49.03058° W 123.10497°	N 49.02772° W 123.10933°
Date	Aug 11, 2003	Aug 11, 2003	Aug 12, 2003	Aug 12, 2003	Aug 12, 2003	Aug 12, 2003	Aug 11, 2003	Aug 11, 2003	Aug 12, 2003	Aug 12, 2003	Aug 12, 2003
Time (PST)	1500	1420	0915	1115	1145	1350	1630	1550	1000	1040	1430
					Density (shoots m^{-2})						
Rep 1	410.80	777.58	777.58	3213.03	513.50	102.70	777.58	337.44	0.53	0.61	8.02
Rep 2	616.20	0.00	102.70	1731.22	264.08	1833.92	1085.68	102.70	0.00	4.67	2.95
Rep 3	865.61	0.00	44.01	1305.75	1965.96	440.14	0.00	1041.67	0.00	5.43	1.91
Mean	630.87	259.19	308.10	2083.33	914.51	792.25	621.09	493.94	0.18	3.57	4.29
Std	185.97	366.56	332.84	817.48	750.43	749.34	456.83	398.98	0.25	2.12	2.67
					Biomass (g m^{-2})						
Rep 1	1.91	7.48	4.40	36.83	2.05	1.76	4.84	0.88	0.15	0.44	28.32
Rep 2	3.81	0.00	0.29	17.46	1.17	20.39	4.69	0.29	0.00	8.36	9.24
Rep 3	2.64	0.00	0.29	12.76	15.70	3.96	0.00	5.13	0.00	8.36	8.95
Mean	2.79	2.49	1.66	22.35	6.31	8.71	3.18	2.10	0.05	5.72	15.50
Std	0.79	3.53	1.94	10.41	6.65	8.31	2.25	2.16	0.07	3.73	9.06

Table 13. Replicate and mean values of *Zostera japonica* density and biomass estimates on Roberts Bank between October 27-29, 2003 (Std = Standard Deviation).

Eelgrass - *Zostera japonica*

	Stations											
	C16	**C17**	**D21**	**D22**	**D23**	**D24**	**E25**	**E27**	**E28**	**F31**	**F32**	**F33**
GPS	N 49.05273° W 123.15477°	N 49.04830° W 123.16345°	N 49.03983° W 123.11993°	N 49.03707° W 123.12370°	N 49.03352° W 123.12878°	N 49.02997° W 123.13472°	N 49.03658° W 123.10715°	N 49.03123° W 123.11568°	N 49.02823° W 123.12062°	N 49.03056° W 123.10497°	N 49.02772° W 123.10933°	N 49.02410° W 123.11433°
Date	Oct 27, 2003	Oct 27, 2003	Oct 27, 2003	Oct 27, 2003	Oct 27, 2003	Oct 27, 2003	Oct 29, 2003	Oct 29, 2003	Oct 29, 2003	Oct 29, 2003	Oct 29, 2003	Oct 29, 2003
Time (PST)	0510	2310	0415	0350	0330	0300	2110	2350	0050	2215	2320	0120
	Density (shoots m^{-2})											
Rep 1	0.00	0.00	0.00	0.00	132.04	14.67	73.36	146.71	29.34	44.01	29.34	0.00
Rep 2	0.00	14.67	73.36	0.00	14.67	0.00	58.69	176.06	117.37	14.67	29.34	29.34
Rep 3	14.67	0.00	29.34	58.69	0.00	0.00	0.00	410.80	0.00	0.00	73.36	44.01
Mean	4.89	4.89	34.23	19.56	48.90	4.89	44.01	244.52	48.90	19.56	44.01	24.45
Std	6.92	6.92	30.15	27.66	59.09	6.92	31.69	118.18	49.87	18.30	20.75	18.30
	Biomass (g m^{-2})											
Rep 1	0.00	0.00	0.00	0.00	1.32	0.59	0.44	0.88	0.29	0.15	0.00	0.00
Rep 2	0.00	0.00085*	0.59	0.00	0.15	0.00	0.15	2.05	0.73	0.15	0.29	0.59
Rep 3	0.00210*	0.00	0.15	0.88	0.00	0.00	0.00	1.91	0.00	0.00	0.44	0.44
Mean	0.00070*	0.00028*	0.24	0.29	0.49	0.20	0.20	1.61	0.34	0.10	0.24	0.34
Std	0.00099*	0.00040*	0.25	0.41	0.59	0.28	0.18	0.52	0.30	0.07	0.18	0.25

*samples weighed on a more sensitive balance

Table 14. Replicate and mean values of *Zostera japonica* density and biomass estimates on Roberts Bank between December 22-24, 2003 (Std = Standard Deviation).

Eelgrass - *Zostera japonica*

	Stations				
	C16	**C17**	**D21**	**D22**	**F33**
GPS	N 49.05273°	N 49.04830°	N 49.03983°	N 49.03707°	N 49.02410°
	W 123.15477°	W 123.16345°	W 123.11993°	W 123.12370°	W 123.11433°
Date	Dec 23, 2003	Dec 23, 2003	Dec 23, 2003	Dec 23, 2003	Dec 24, 2003
Time (PST)	0230	0205	2140	2245	0120
	Density (shoots m^{-2})				
Rep 1	102.70	73.36	146.71	0.00	0.00
Rep 2	161.38	264.08	58.69	58.69	88.03
Rep 3	73.36	0.00	14.67	0.00	278.76
Mean	112.48	112.48	73.36	19.56	122.26
Std	36.60	111.30	54.90	27.66	116.35
	Biomass (g m^{-2})				
Rep 1	0.00	0.00	0.59	0.00	0.00
Rep 2	0.00	0.44	0.00	0.15	0.15
Rep 3	0.15	0.00	0.15	0.00	1.03
Mean	0.05	0.15	0.24	0.05	0.39
Std	0.07	0.21	0.25	0.07	0.45

Table 15. Replicate and mean values of *Zostera japonica* density and biomass estimates on Roberts Bank between February 16-17, 2003 (Std = Standard Deviation).

Eelgrass - *Zostera japonica*

	Stations						
	C17	**D21**	**D22**	**D23**	**F31**	**F32**	**F33**
GPS	N 49.04830° W 123.16345°	N 49.03983° W 123.11993°	N 49.03707° W 123.12370°	N 49.03352° W 123.12878°	N 49.03058° W 123.10497°	N 49.02772° W 123.10933°	N 49.02410° W 123.11433°
Date	Feb 17, 2003	Feb 16, 2003	Feb 17, 2003	Feb 17, 2003	Feb 16, 2003	Feb 16, 2003	Feb 17, 2003
Time (PST)	1955	1700	2320	2115	1740	1755	2235
	Density (shoots m^{-2})						
Rep 1	14.67	44.01	0.00	161.38	44.01	14.67	660.21
Rep 2	0.00	0.00	88.03	58.69	0.00	73.36	190.73
Rep 3	0.00	0.00	0.00	14.67	0.00	0.00	205.40
Mean	4.89	14.67	29.34	78.25	14.67	29.34	352.11
Std	6.92	20.75	41.50	61.47	20.75	31.69	217.94
	Biomass (g m^{-2})						
Rep 1	0.00187*	0.00890*	0.00	0.44	0.15	0.00	3.96
Rep 2	0.00	0.00	0.29	0.29	0.00	0.29	0.88
Rep 3	0.00	0.00	0.00	0.00	0.00	0.00	1.76
Mean	0.00062*	0.00297*	0.10	0.24	0.05	0.10	2.20
Std	0.00088*	0.00420*	0.14	0.18	0.07	0.14	1.30

*samples weighed on a more sensitive balance

Table 16. Replicate and mean values of *Zostera marina* density and biomass on Roberts Bank between June 15-16, 2003 (Std = Standard Deviation).

Eelgrass - *Zostera marina*			
	Stations		
	C19	D24	E29
GPS	N 49.03173° W 123.19428°	N 49.02997° W 123.13472°	N 49.02393° W 123.12653°
Date	Jun 16, 2003	Jun 15, 2003	Jun 15, 2003
Time (PST)	1330	1400	1500
	Density (shoots m^{-2})		
Rep 1	211.86	169.49	21.19
Rep 2	84.75	84.75	21.19
Rep 3	148.31	84.75	21.19
Mean	148.31	112.99	21.19
Std	51.90	39.95	0.00
	Biomass (g m^{-2})		
Rep 1	179.03	92.37	21.61
Rep 2	56.14	47.88	37.50
Rep 3	59.96	74.79	33.47
Mean	98.38	71.68	30.86
Std	57.05	18.30	6.74

Table 17. Replicate and mean values of *Zostera marina* density and biomass estimates on Roberts Bank between August 11-12, 2003 (Std = Standard Deviation).

Eelgrass - *Zostera marina*		
	Stations	
	D23	D24
GPS	N 49.03352° W 123.12878°	N 49.02997° W 123.13472°
Date	Aug 12, 2003	Aug 12, 2003
Time (PST)	1350	1325
	Density (shoots m^{-2})	
Rep 1	381.46	190.73
Rep 2	0.00	102.70
Rep 3	88.03	161.38
Mean	156.49	151.60
Std	163.08	36.60
	Biomass (g m^{-2})	
Rep 1	70.57	165.05
Rep 2	0.00	60.59
Rep 3	28.32	142.31
Mean	32.96	122.65
Std	29.00	44.85

Table 18. Replicate and mean values of *Zostera marina* density and biomass estimates on Roberts Bank between October 27-29, 2003 (Std = Standard Deviation).

Eelgrass - *Zostera marina*					
	Stations				
	C19	D23	D24	E28	F33
GPS	N 49.03173°	N 49.03352°	N 49.02997°	N 49.02823°	N 49.02410°
	W 123.19428°	W 123.12878°	W 123.13472°	W 123.12062°	W 123.11433°
Date	Oct 29, 2003	Oct 27, 2003	Oct 27, 2003	Oct 29, 2003	Oct 29, 2003
Time (PST)	0240	0330	0300	0050	0120
	Density (shoots m^{-2})				
Rep 1	58.69	0.00	132.04	88.03	73.36
Rep 2	0.00	102.70	73.36	132.04	102.70
Rep 3	0.00	0.00	58.69	161.38	0.00
Mean	19.56	34.23	88.03	127.15	58.69
Std	27.66	48.41	31.69	30.15	43.19
	Biomass (g m^{-2})				
Rep 1	56.92	0.00	50.91	30.81	30.37
Rep 2	0.00	11.59	30.08	43.57	32.28
Rep 3	0.00	0.00	25.53	53.70	0.00
Mean	18.97	3.86	35.50	42.69	20.88
Std	26.83	5.46	11.05	9.36	14.79

Table 19. Replicate and mean values of *Zostera marina* density and biomass estimates on Roberts Bank between December 22-24, 2003 (Std = Standard Deviation).

Eelgrass - *Zostera marina*					
	Stations				
	C19	E28	E29	F33	F34
GPS	N 49.03173°	N 49.02823°	N 49.02393°	N 49.02410°	N 49.02045°
	W 123.19428°	W 123.12062°	W 123.12653°	W 123.11433°	W 123.11985°
Date	Dec 23, 2003	Dec 24, 2003	Dec 24, 2003	Dec 24, 2003	Dec 24, 2003
Time (PST)	2330	0150	0025	0120	0055
	Density (shoots m^{-2})				
Rep 1	58.69	132.04	88.03	58.69	88.03
Rep 2	117.37	58.69	88.03	102.70	14.67
Rep 3	58.69	44.01	73.36	0.00	29.34
Mean	78.25	78.25	83.14	53.79	44.01
Std	27.66	38.51	6.92	42.07	31.69
	Biomass (g m^{-2})				
Rep 1	25.23	37.85	44.31	21.13	96.98
Rep 2	31.69	14.67	83.33	36.83	8.36
Rep 3	15.70	13.06	61.33	0.00	22.15
Mean	24.21	21.86	62.99	19.32	42.50
Std	6.57	11.33	15.98	15.09	38.93

Table 20. Replicate and mean values of *Zostera marina* density and biomass estimates on Roberts Bank between February 16-17, 2003 (Std = Standard Deviation).

Eelgrass - *Zostera marina*

	Stations				
	D24	**E28**	**E29**	**F33**	**F34**
GPS	N 49.02997° W 123.13472°	N 49.02823° W 123.12062°	N 49.02393° W 123.12653°	N 49.02410° W 123.11433°	N 49.02045° W 123.11985°
Date	Feb 17, 2003	Feb 17, 2003	Feb 17, 2003	Feb 17, 2003	Feb 17, 2003
Time (PST)	2130	2300	2115	2235	2215
			Density (shoots m^{-2})		
Rep 1	102.70	278.76	234.74	0.00	132.04
Rep 2	132.04	146.71	132.04	0.00	88.03
Rep 3	73.36	190.73	132.04	29.34	44.01
Mean	102.70	205.40	166.28	9.78	88.03
Std	23.96	54.90	48.41	13.83	35.94
			Biomass (g m^{-2})		
Rep 1	13.35	40.93	49.59	0.00	68.66
Rep 2	23.62	17.46	56.92	0.00	50.03
Rep 3	11.44	22.74	39.32	2.35	10.56
Mean	16.14	27.04	48.61	0.78	43.08
Std	5.35	10.05	7.22	1.11	24.22

Table 21. GPS coordinates for stations sampled on Roberts Bank. Sampling stations not visited are represented by "-".

Station	Latitude	Longitude
A1	-	-
A2	N 49.11190°	W 123.22265°
A3	N 49.10980°	W 123.22623°
A4	N 49.10167°	W 123.24248°
A5	N 49.09358°	W 123.26085°
A6	N 49.08555°	W 123.28115°
A7	-	-
B8	-	-
B9	-	-
B10	N 49.07933°	W 123.19400°
B11	N 49.07055°	W 123.21350°
B12	N 49.06262°	W 123.22867°
B13	N 49.05370°	W 123.24553°
B14	N 49.04615°	W 123.26015°
C15	-	-
C16	N 49.05273°	W 123.15477°
C17	N 49.04830°	W 123.16345°
C18	N 49.04122°	W 123.17783°
C19	N 49.03173°	W 123.19428°
D20	N 49.04205°	W 123.11592°
D21	N 49.03983°	W 123.11993°
D22	N 49.03707°	W 123.12370°
D23	N 49.03352°	W 123.12878°
D24	N 49.02997°	W 123.13472°
E25	N 49.03685°	W 123.10715°
E26	N 49.03443°	W 123.11097°
E27	N 49.03123°	W 123.11568°
E28	N 49.02823°	W 123.12062°
E29	N 49.02393°	W 123.12653°
F30	N 49.03352°	W 123.10128°
F31	N 49.03058°	W 123.10497°
F32	N 49.02772°	W 123.10933°
F33	N 49.02410°	W 123.11433°
F34	N 49.02045°	W 123.11985°